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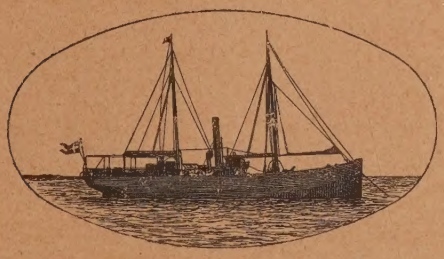
Report

of

The Danish Biological Station

to

The Board of Agriculture.



XVIII.

1909.

By

C. G. Joh. Petersen,

Ph. D.

Translated from „Fiskeri-Beretning for 1908".

Copenhagen.
Centraltrykkeriet.
1909.

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I.

The Yield of the Limfjord fisheries in recent years

and the

Transplantation of Plaice in 1908.

With 6 tables and 1 chart.

By

C. G. Joh. Petersen.

We have both from earlier and more recent times a good deal of information regarding the Limfjord fisheries and their yield. I need not mention here the earlier years, when the fjord was closed towards the west and almost fresh in the large western expansions and when the much discussed herring fishery took place at Nibe. Whoever may desire information regarding these earlier times I may refer amongst others to the present General Post-Director, Cand. polit. V. Kiørboe's work "Om det gamle Limfjordssildefiskeri og dets Betydning" in the "Nationaløkonomisk Tidsskrift", 3. R., 2. Bd. 10. Hæfte 1895. It is more especially the later period, for which we have good, continuous statistics, which is of interest here. These statistics are to be found in the "Fiskeri-Beretninger" from 1890—1908.

The figures in Table I give a view over the Limfjord fisheries since 1890; Table II gives a graphic representation of the value of the same fisheries since the year named. We notice at once that the eel fishery is the most important of all the fisheries; next come the flat-fish fisheries, in which the plaice plays quite the most important part. The other flat-fishes, flounder, turbot, dab, are with exception of the flounder of no great importance. The yield of the eel fishery in recent years has been over Kr. 800,000; the flat-fish fishery varies between ca. 200,000 and 500,000 Kr. From Table II it will be seen that in 1903 these two fisheries were almost equally great; namely, the eel fishery small ca. $^1/_2$ million, and the flat-fish fishery large also ca. $^1/_2$ million Kroner. Of the other fisheries the cod and herring fisheries are not inconsiderable; each 100,000 to 200,000 Kr. The herring fishery has been improving in recent years in the western parts of the fjord.

The lobster fishery yields ca. 30,000 Kr.; it was greatest in 1898—99.

The prawn fishery made a beginning about 1891 on the initiative of outside fishermen from Sealand and Funen; it culminated with ca. 120,000 Kr. yearly in 1894 and 1895, then decreased to 20,000 Kr. in 1896, in which year and the next following almost no prawn fishery was carried on. Thereafter it again increased, after these years of peace, up to 70,000 Kr. in 1901, decreasing then to 20,000 Kr. in 1904 and in 1908 again rose to ca. 60,000 Kr.; at the same time however the price has risen enormously, so much so that the prawn fishery in lbs. is now far from being what it was in earlier times.

Under the heading "other fisheries" in Table I are included partly wild duck, and partly in later years trout fishery, the latter of which has somewhat increased.

From the total product in Table I and from Table II it will be seen at once, that the Limfjord fishery has almost regularly advanced from ca. 800,000 Kr. in 1890 to twice that amount in 1908. I may explain that in 1886—87 it was even only ca. $^1/_2$ million Kr. This great advance is due both to a more intensive fishery with better apparatus, motor boats etc. and to higher prices for almost all species of fish.

It is however first and foremost the eel which is now taken in greater abundance than formerly, and what has contributed to this result in later years has been, as indeed over the whole country, the greater development of the eel-trap fishery for silver eels. More and more traps have been added in the Limfjord; but they have likewise been improved, with higher rims, and they have gradually often been replaced by eel ground-nets the upper rim of which is specially high so that the eel cannot get over it but must enter the trap. This knowledge, that the eel may swim high up in the water, and often perhaps as a rule does so, which was gained during the Biological Station's experiments with light to seek for and capture the eels, has quickly come into practical use, as also the knowledge that there is no reason for sparing the emigrating silver eels, which knowledge now seems at last to have reached down amongst and been accepted by the fishing population.

The yield of the oyster fishery is not included here; in the later years it can be placed at ca. 300,000 Kroner in value, as about $1^1/_2$ million oysters are fished yearly and the price paid is ca. 20 Øre pr. oyster in Copenhagen. Within recent years the State has had a direct income from this of ca. 80,000 Kr. The total value of the Limfjord fisheries in 1908 may therefore be placed at very nearly 2 million Kr.

On comparing the curve for the plaice (flat-fish) and that for the eel on Table II it will be noticed that when the one rises or falls the other falls or rises; these two fisheries thus supplement one another, which may be considered as partly due to the fact that westerly winds during the spring and summer with westerly current and low temperatures are advantageous for the immigration of the plaice and not harmful to their growth, whilst the eel requires warm summers to grow rapidly; but at the same time this effect is most probably also increased by the fact, that the fishermen in the good eel years keep mostly to the eel fishery and thus lay less stress on the plaice fishery, while the reverse is the case in the good plaice years. The good plaice year of 1903 is especially remarkable for the Limfjord. That year according to Dr. A. C. Johansen's investigations was an unusually small year for the Esbjerg plaice fishery; large quantities of undersized fish were found there, but their growth was relatively small compared with the growth in 1904 and 1905. Regarding this I may refer to his "Contributions to the Biology of the Plaice", I; Meddelelser fra Kommissionen for Havundersøgelser p. 65, where he mentions that each single one of our waters has its own maxima and minima with regard to the yield of the plaice fishery, as also to "Contributions" II, p. 60 and III, p. 37.

On Table II it is seen that the curves for the cod and herring have a tendency to follow rather the plaice curve than the eel curve. For this however a longer series of years is required to judge with certainty.

The curves for the prawn and lobster are also shown on Table II; I shall not enter into the details of these.

Under the herring fishery is included especially in recent years no inconsiderable quantities of the sprat. It is on the whole a shortcoming in the Limfjord statistics that it indicates more what is fished by the different apparatus; thus, with the flat-fish seines not only the plaice but also flounder and other flat-fish, with the eel apparatus not only the eel but also cod and flat-fish; but on the whole however the fisheries mentioned are so mainly based on one definite species of fish, namely plaice, eel etc., that the statistical data are certainly at least just as reliable here as all other fisheries statistics. Under such conditions great exactitude is not to be expected.

The species which play any important part in the Limfjord are the eel, plaice, flounder, cod, herring, sprat and trout, further oysters, lobster and prawns. Of these certainly the flounder, trout, oysters, prawns and probably the lobster pass the whole of their life in the fjord and reproduce in it or in adjacent freshwater (trout); they may be called stationary fish ("stand" animals); but by far the most important fishes, eel and plaice, enter as young from the North Sea or Kattegat and grow large in the fjord; but they do not reproduce in the fjord. The cod also certainly enters partly as adult partly as young from the sea, but probably only reproduces to a small extent in the fjord itself. The herring on the other hand spawns in the fjord, but migrates out and in at different seasons; the stock of sprat is certainly also recruited mainly by immigration.

The fjord is thus for the two most important fish, eel and plaice, required to depend upon the growth of the immigrated young of these; that a number of not quite small plaice migrate in does not alter this condition in the main; unless they have passed some time in the fjord, they are only of small value. The fishery for these two species is now carried on so intensively, that there can be no talk of any stock of them being spared from year to year; on the contrary practically all are fished up yearly that grow up to a suitable size; with regard to the eel it is known further, that the adult eels (silver eels) endeavour each year to migrate from the fjord, and those of them which are not caught in the autumn are thus lost for ever in the sea. On account of this extreme fishing in the course of the year and the immigration of these fish (eel and plaice), the fishery for these has a slack period in spring and late winter; but gradually as the stock again increases. during the warmer part of the year, the fishery again improves, to culminate in the autumn. It is here a great gain for the population that in the cold years, when the eel as a southern fish seems to grow less well, the plaice is flourishing.

I shall not endeavour here to indicate everything that might be done to improve the fisheries of the fjord in general; I have discussed this matter for the oyster fishery in the XV and XVII Reports from the Biological Station; but in the following section I shall give an account of the plaice fishery, based on a close study of the biology of the plaice in the fjord and show what has been done to improve the fishery of this species, partly by means of fishery legislation with regard to a size-limit for this fish, partly by means of transplantation of young plaice from Nissum-Bredning to the inner waters.

Table II shows that, with the exception of the remarkable year 1903, the

year 1908 has given the largest yield in money of the plaice fishery in the Limfjord itself, namely ca. 422,000 Kr., which has at any time been reached, in spite of the fact, as can be seen from Table II, that in 1908 the eel fishery was quite excellent; as already mentioned these two fisheries are not usually good in the same years. It seems permissible therefore to assume, that the large yield of the plaice fishery in 1908 has been mainly due to the transplantation and the protection, which was set in operation just in that year and carried out on a large scale, nor is there any doubt that this transplantation has had great influence on this result; to determine more exactly how much it has contributed to the increase will be attempted in the following.

An approximate view over the places in the Limfjord where the plaice fishery is carried on with the best results can be obtained directly from the "Fiskeri-Beretninger", as the fjord for statistical purposes is divided into 3 parts, a western A from Thyborøn to the waters south and west round Mors with Thisted Bredning, a central B with Sallingsund, Livø Bredning and the waters as far as Skive and Hjarbæk, and also an eastern part C from Løgstør to Aalborg and Hals (see the Chart).

Table III gives the yield for these 3 divisions from 1890 to 1908. It will at once be seen that the yield in C is so inconsiderable compared with the yield in A and B, that we can quite exclude it from consideration; more especially as a part of the yield given under C is really fished in B. The area within C in which the plaice could live is also in reality but small, as only the true "Sejldyb", which is quite narrow over almost the whole of the long distance from Løgstør to Hals, is suited to the plaice.

On Table IV curves are given to show the monetary yield in A and B. We see from this Table IV that the curves for A and B vary considerably from year to year, but that there is nevertheless a certain correspondance between them, as they rise or fall on the whole simultaneously; in 1902 and especially in 1903 the yield in B was much greater than in A; otherwise B is usually somewhat lower than A. With exception of the years 1903 and 1908 no distinct advance can be noticed in the fishery as a whole. The average yield for both divisions over 18 years is however very near 140,000 Kr.

It is however far from the case, that equally many plaice are fished everywhere in the waters belonging to A and B; to obtain information on this point, extracts (see Table V) have been taken from the special statistics to show what is taken in (1) the waters west and north round Mors, from Næs-Sund to Feggesund (Thisted), (2) Riisgaard Louns and Hvalpsund with the more southerly appertaining waters, (3) Hannæs Bredning, i. e. (see Chart) the part of Livø Bredning lying north of Livø. These areas constitute a no inconsiderable portion of the whole area of A and B; (1) lies in A, (2) and (3) in B. It has not been possible to distinguish sharply the fisheries in these areas, but the main result, that in (2) and (3) together only ca. 20,000 Kr. is taken yearly, except in 1908, as against ca. 140,000 Kr. in the whole of B, shows that the plaice fishery in B is not carried on in the waters belonging to (2) and (3), but for the most part in Sallingsund and the southern part of Livø Bredning; a fact that every one acquainted with the fishery conditions in the fjord knew beforehand. The yield for (1), (2) and (3)

is represented by curves on Table IV. We see at once how inconsiderable is the yteld for (2) Riisgaard and Hvalpsund and (3) Hannæs and Løgstør Bredning in comparison with the whole yield for B, with exception of 1908. On the other hand, the yield for (1) Thisted Bredning and the waters west of Mors is by no means inconsiderable, though the area of (1) is less than that of (2) and (3). For (1) a slight rise can be noticed from 1890 and 1891 to 1907, beginning with the year 1892, when the first large transplantation of small plaice occurred. 1896 and 1897 were bad years in the whole fjord; in 1896 there was no transplantation into Thisted Bredning; thus 1896 and 1897 were bad years there. It is north notice that the curve for (1) Thisted goes up and down with the curves for A and B; we might thus think that an immigration into Thisted really took place, which was of importance for the stock there; the yield, ca. 20,000 Kr., for Thisted before transplantation was begun might also be taken to indicate that a larger stock of plaice existed there before transplantation. But on the one hand it is impossible to distinguish in the statistics exactly what has been taken by the fishermen of these waters outside them, and on the other the statistics include not only plaice but also flounder and other fish taken in the flat-fish seine and gill-nets, so that we cannot be surprised that the curve follows the curves for A and B in the fluctuations, nor that the yield before the transplantation was 20,000 Kr. yearly; this last obviously seems mainly or almost exclusively the flounder fishery, which even now is not inconsiderable in these waters. In 1895 I examined into and discussed the small, original stock of plaice in Thisted Bredning and neighbouring waters (see Biological Station's Report VI, 1895 (1897)), where this stock was determined by means of fishing experiments on plaice which were liberated and in many cases marked; a method which has been used within recent years in the North Sea at Heligoland by Fr. Heincke in order also to determine the number of plaice on a given area of the sea-bottom.

The whole yield of even the plaice transplantation into Thisted Bredning and west of Mors has not usually exceeded ca. 20,000 Kr. before 1908, according to the information given by the fisheries societies; it was thus a relatively inconsiderable sum in the whole plaice fishery of the Limfjord and it easily disappears in statistics which are not specially arranged to display it. The two years before transplantation, 1890 and 91, give only (see Table V) a yield of ca. 21,000 Kr., but the yield of the later years is on an average 37,000 Kr., in 1908 on the other hand ca. 65,000 Kr.

With regard to the results of the transplantations before 1908 into Hannæs Bredning and the more southern waters, the yield of which has been even less than that in Thisted, I shall not here discuss them more closely; here also a careful analysis can detect an advance in the statistics of recent years; but what is incumbent on me to show here is, that these large areas gave before 1908 a very small yield of plaice in comparison with other areas in the Limfjord. When we know further, that even in Nissum Bredning only a few thousand kroners' worth of plaice are fished annually, not because there are not sufficient of them but because they are too small for commercial purposes, we have the result that the true large plaice fishery is restricted to the waters from Oddesund with the waters around Venø, Kaas Bredning and Sallingsund up

towards Livø. These waters before 1908 gave almost $^4/_5$ ths of the whole plaice yield of the fjord; and only these have a large, natural stock of plaice of use as food. The boundaries for this stock in Livø Bredning are obviously variable in the different years and depend on the immigration of the plaice from the west, sometimes in larger or smaller quantities, and the immigration by a natural route into the waters west and north of Mors and east of Salling (Riisgaard—Louns) is obviously always very small. It is here that we can be of assistance with the immigration by an artificial route: namely transplantation.

On the Chart all the districts where there is a natural and numerous stock of plaice are shaded with vertical lines, namely the waters from Thyborøn to Nykøbing; where the plaice stock is small, and where therefore transplantation has taken place in 1908, the shading is made with horizontal lines. The south-western part of Livø Bredning, where no transplantation was carried out in 1908, but where there is sometimes a fairly rich stock of plaice which have migrated in by natural route, is not shaded. This is the area indicated on the Chart as a mixed region.

The first large transplantation was carried out in 1908, as will be described in the following.

Transplantation on a large scale, such as was originally recommended by the Biological Station (Report VI), was as mentioned carried out in the spring of 1908. Whilst hitherto some few hundred thousands of young plaice had certainly been planted into the waters at Thisted, in Louns Bredning and in Livø Bredning off Løgstør, the plan was now formed of populating all the waters west and north of Mors, north and east of Livø to right down to the south in Louns Bredning with 20 plaice per Td. land (15 pr. acre) (see vertical shading on Chart), and at the same time to protect them against the seine fishery in summer and in part of autumn as also by increasing the limit size to 9 and $9^1/_2$ inches to the root of the tail, thus 1 and $1^1/_2$ inches longer than the otherwise prevailing 8 inches. It was the new fishery law of 4th May 1907 which placed the necessary powers at the disposal of the Board of Agriculture for this purpose.

The whole area over which transplantation was carried out in 1908 was 67,680 Td. land; only the area within the 3 fathoms is included here. We should thus have $20 \times 67{,}680$ plaice $= 1{,}353{,}600$ fish. The expense to the State amounted to 15,300 Kr., which means a little over one øre per plaice transplanted. The fish were captured just within the Thyborøn Channel (see area marked on Chart) by a number of small boats from the Limfjord with wells and by 4 large Frederikshavn fishing cutters with motors, and were transported into the fjord to be distributed partly by the welled boats, partly by the 4 cutters mentioned. The whole process of transplantation conducted under the guidance of the fisheries inspectors was begun on April 3rd 1908 and completed on April 11th 1908. On the last day just as many plaice were taken in the seines as on the first, so that the fishermen could not notice any decrease whatsoever in the numbers of the stock at the Thyborøn Channel, although the fishing was carried on over an area of but a few miles' extent in all directions. The stock was in 1908 and is as a rule so enormously great that 1 or 2 millions more or less cannot be detected on the yield of the fishery. That there were various shortcomings in the practical carrying out of the transplantation in this first year may just be mentioned here; thus, fish of

rather small size were included and in quiet weather the small sailing boats could not transport the fish quickly enough into the fjord, so that some died on the journey. These shortcomings can easily be overcome in the future. On the whole the transplantation proceeded regularly under the inspector's control. The fish were taken exclusively with the seine not with the gill-net, which easily damages the fish; the seine was hauled in by hand as well as with the assistance of the motor; in both cases the fish were fully alive and well. The fish were not as rule counted, but numbered in baskets or boxes, the contents of which had been determined once for all by counting.

The places where the fish were liberated are as mentioned marked on the Chart by vertical shading; they lie both in division A and especially in division B of the statistics. If we would therefore gain from the statistics some information with regard to what has been earned from the transplantation experimets of recent years and especially in 1908, the Limfjord "fishing places" noted in the statistics for the flat-fish fisheries since 1896 must be separated into the waters where there is a large, natural stock of plaice and those where there is a smaller or almost no stock and into which the plaice were therefore transplanted. In other words, we must to the first division A reckon Sallingsund at least up to Nykøbing, whilst the waters west and north of Mors with Thisted are taken from A and kept separate; similarly the waters Riisgaard and Louns Bredning with Skive Fjord are kept separate; the northern part of Livø Bredning and east of Livø down to east of Fuur should also in reality be kept separate, since it was only here that plaice were liberated in Livø Bredning; but owing to the impossibility of obtaining information exclusively for these parts of Livø Bredning, as also because the fish transplanted migrate in fact out beyond these boundaries and spread to the south into Livø Bredning we must be content with information of the catch for the Livø Bredning as a whole. We must remember however that in certain years an extremely great immigration may take place naturally into the southern parts of this water (not shaded on the Chart).

On Table VI the Limfjord is thus divided into 4 divisions in statistical regards: (1) embracing all waters from Thyborøn through Oddesund, with Venø, Kaas Bredning and Sallingsund to Nykøbing; (2) the waters west and north of Mors; (3) Riisgaard and Louns Bredninger; (4) the whole of Livø Bredning north of Salling. In (1) as mentioned no plaice were transplanted, in (4) plaice were transplanted into the northern parts, in (2) and (3) they were distributed everywhere. From Table VI it appears undoubted that the transplantation in 1908 has given great results, especially in Thisted Bredning and in Louns and Riisgaard, as 1908 is the largest year in them both, with ca. 28,000 Kr. more in each than the average of the 12 preceding years, even though already in several earlier years plaice have been transplanted into them with a yearly yield of ca. 30—40,000 Kr. altogether, according to the statements of the fisheries societies. The yield in them for 1908 must therefore be increased by 30—40,000 Kr. + 2 × 28,000 Kr. = ca. 86—96,000 Kr.

The water Thyborøn—Nykøbing also shows in 1908 an increased yield of ca. 51,000 Kr.; and although a good year in this division is not always followed by a good year in Livø Bredning, this also in 1908 shows an increased yield of

ca. 27,000 Kr. over the average of the 12 preceding years; to this must be further added the yield of the transplantation experiments in this Bredning in recent years, the value of which however is not exactly known.

The whole yield of the transplantation experiments in 1908, calculated on this method, should therefore be

Thisted	ca. Kr.	28,000
Riisgaard—Louns	- —	28,000
Yield of the earlier experiments here	- —	30—40,000
Increased yield in Livø Bredning	- —	27,000
Yield of the experiments in earlier years here		x
Total		113—123,000 Kr. and something more for x.

To judge from these data, the transplantation experiments in Livø Bredning with 27,000 Kr. above the average have not given nearly such a good result as in the Thisted and Riisgaard divisions. But in the case of Livø Bredning I must warn against too much faith being placed in these figures; I have long been prepared to see that great statistical difficulties would be found here in the determination of the yield of the transplantation experiments.

Thisted with Visby Bredning is undoubtedly the best defined area for the experiments; nor are Riisgaard and Louns Bredning so badly defined. If we calculate that the fishery at Thisted, where in 1908 ca. 18,400 score of plaice were inplanted, has yielded 65,000 Kr. ÷ the old stock of ca 20,000 Kr. flounder, thus 45,000 Kr., and that the fishery in Riisgaard Louns in 1908, where 15,200 score were inplanted, has yielded 42,000 Kr. ÷ the old stock of at most 10,000 Kr. flounder, thus ca. 32,000 Kr., the over 36,000 score of plaice transplanted into the northern parts of Livø Bredning in 1908 should have given there a corresponding yield, namely ca. 70,000 Kr. The yield of the whole inplanting in 1908 was thus 45,000 + 35,000 + 70,000 Kr. = 145,000 Kr. In Livø Bredning to the north of Salling the statistics give for this year that the yield was ca. 112,000 Kr., which seems fairly small, but may very well agree with the view of the fishermen that the natural immigration in 1908 was extremely slight. In the spring the fishermen follow of course the natural immigration from day to day and seem to have good information regarding it.

Whether we use the one or the other of these 2 methods of calculation, we obtain a yield from the transplantation experiments in 1908 of considerably over 100,000 Kr., but under 150,000 Kr.; it may be mentioned here, that the results of inspection in Jutland have given, that it is considered, that the yield lies near 133,000 Kr., which agrees very well with these reports.

The sum of ca. 15,000 Kr. given by the State in spring must therefore be considered to have already become almost 7—8 times as great in the course of 9 months in 1908; but further, all the transplanted plaice are not yet fished out and they usually become very large and valuable in the spring, so that we cannot actually as yet judge completely of the whole results of the transplantation experiments. It can only be said that a more profitable undertaking, the results of which can be directly traced, is not known in Danish fisheries history; nor so far as I know in any other land; and the matter still contains possibilities of development.

The year 1908 is as regards the flat-fish fishery the second largest year in the history of the Limfjord, 135,000 Kr. higher than the average of the 12 preceding years; 1903 was larger; in 1903, 496,000 Kroners' worth was fished against 420,000 Kr. in 1908, but 1903 was such a remarkable year, in regard to the conditions of wind and of the obviously accompanying air temperature and currents in the fjord, that it cannot be compared with any other year. Through the friendly assistance of the Meteorological Institute I have obtained information regarding the winds of that and neighbouring years, and this information clearly shows how the winds in March, April and May were very predominantly westerly, just in the period when the plaice are about to be carried into the Bredninger by the westerly currents resulting from these winds.[1]) There is no doubt that in that year an immense, natural immigration took place into the Livø Bredning; for this reason the results attained were greater than those given by artificial transplantation.

It may be considered, as mentioned, that in 1908 we have not obtained the yield of the whole number of transplanted plaice, partly because they have not yet been caught in the nets, partly because they have come into the nets but have been eaten by various animals without being of any use to man. Among these animals which feed upon the fish caught in the nets, must first of all be named the gastropods, "Konkylier" as they are called in the Limfjord; they eat up all the flesh of the plaice, so that only the skin and bones remain; how much is lost in this way is not easy to calculate, as it depends on the wind and weather and other circumstances, but considerable damage is caused by these gastropods (*Buccinum* and *Nassa*); we must therefore try to reduce or if possible to exterminate these animals. This can only be done with the help of the fishermen; and the matter will, it is hoped, be already begun in 1909 by the Biological Station with the cooperation of the fishing population.

If from the 100,000—150,000 Kr., obtained from the transplanted plaice in 1908, we deduct ca. 15,000 Kr., the cost of carrying out the transplantation, the remainder is to be regarded as net yield, as the fishermen have not made any special or new preparations for catching the transplanted fish, and the trouble of catching many plaice is almost the same as in taking fewer, since the nets must in any case be put out.[2])

Although the result obtained from the transplantation experiments in 1908 must be called good, in round numbers estimated to 120,000 Kr., yet much more might come from such work in the future, when experience has shown how all

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[1]) 1903 was indeed a remarkable year, as the cod fisheries at the Lofotens were quite a failure, the seals from the Arctic region migrated down along the coasts of Norway and here with us an unusual number of seals were shot.

[2]) Table III last column shows, that in some years the yield in pounds, but not in Kroner, of the Limfjord plaice fishery has been considerably greater than in 1908. If the weight data of the statistics, which seem to be much more based on estimates than the Kroner, are at all sufficiently reliable, this condition must come from there having been specially many small, cheap plaice caught in the western Bredninger; since the price of good, large fish has not been declining for a long number of years. To transform the many, small, cheap or quite valueless fish in the western Bredninger to good, dear fish in the inner Bredninger, is indeed just the aim of the transplantation experiments; the results should therefore preferably be shown in monetary yield, and this, as mentioned, has only in one year, 1903, been higher than in 1908.

chances can be utilised; because 1,400,000 transplanted fish should give at least 15 øre per fish, if the death-rate is but small during transport and also later in the nets, because the price is 30 øre per pound and the fish are at least $^1/_2$ a pound on recapture; in reality they become much larger on an average; but 15 × 1,400,000 is 21,000,000 øre or 210,000 Kr., and this has not by far been reached this year. If all the fish came to be used and were retaken in the course of one year, we should rather have up to 300,000 Kr.; this must be aimed at in the future, as also knowledge of how many plaice can as a rule be planted per acre of land. In 1908 also such good prices have not been obtained for the fish recaptured as might be obtained. Often in fact they had to be sent in dead condition to Copenhagen, but the method of killing and cleaning has often left a good deal to be desired; thus care has not always been taken that the blood ran out of the fish, often it remains in the fish and can be seen later as dark streaks along the bones, a thing disliked by all who know what well-cleaned plaice mean. Either the whole head must be cut off, or the spinal column cut over, and in any case the fish should be gutted. If the fish are treated well, the transplantation experiments will yield more than has been obtained this year.

Table I.

The who

Yield in pounds (Ol = 80) and Kron

(Oyster fis

	Herring fishery.		Eel fishery.		Flat-fish fishery.		Cod fishery.	
	Ol.	Kr.	Pd.	Kr.	Pd.	Kr.	Pd.	K
1890	»	62.235	»	356.031	»	252.665	»	148.
1891	»	70.310	»	441.090	»	225.375[1])	»	158.
1892	»	64.440	»	462.481	»	300.870	»	164.
1893	»	71.400	»	528.093	»	310.090	»	164.
1894	»	76.420	»	549.859	»	319.950	»	213.
1895	»	68 577	»	538.052	»	300.280	»	212.
1896	56.628	76,549	1.421.155	501.712	»	228.557	1.028.891	179.
1897	59.880	77.230	1.508.620	533.340	»	209.560	1.448.600	130.
1898	79.560	94.020	1.354.720	472.630	2.124.600	277.590	1.668.200	121.
1899	66.790	92.270	1.345.658	582.155	»	294.910	1.788.050	130.
1900	66.029	119.305	1.506.729	642.129	2.710.710	310.650	1.077.350	100.
1901	95.611	142.410	1.711.065	737.965	1.342.672	195.570	979.860	80.
1902	126.683	183.485	1.284.735	527.680	2.454.299	331.770	1.623.585	120.
1903	170.640	194.765	1.011.400	488.375	3.215.410[1])	496.460	1.331.950	98.
1904	119.710	167,460	1.335.991	604.955	2 291.775	354.155	1.221.632	113.
1905	141.600	205.948	1.798.936	839 020	1.460.810	229.415	1.749.966	167.
1906	109.405	247.150	1.844.084	855.416	964.040	218.680	1.013.355	147.
1907	91.313	258.530	1.732.503	826.915	1.406.196	298.260	931.597	130.
1908	102.290	213.130	1.686.661	813.320	1.894.643	421.710	829.929	116.

Limfjord,

the different fisheries in 1890—1908

included).

bster fishery.		Prawn fishery.		Other fisheries.	Total.	Notes.
d.	Kr.	Pd.	Kr	Kr.	Kr.	
»	29.922	»	895	8.900	859.453	[1]) These figures differ from those given in the statistics, which are wrong.
»	37.865	»	2.965	6.665	942.430[1])	
»	33.200	»	9.310	4.795[1])	1.039.672[1])	
»	24.960	»	14.960	11.725	1.125.598	
»	26.230	»	118.450	5.020	1.309.004	
»	26.805	»	129.345	5.100	1.280.739	
500	37.040	134.255	79.093	7.950	1.110.896	
450	37.360	68.730	34.185	6.992	1.029.372	
450	45.775	36.511	19.200	11.485	1.032.660	
450	53.450	39.559	28.150	9.440	1.186.805	
200	34.200	32.374	31.300	7.675	1 245.489	
187	34.576	140.793	70.315	8.876	1.270.647	
893	24.575	68.910	37.130	17.816	1.243.286	
477	37.350	57.400	33.590	14.095	1.362.937	
470	32.400	38.399	20.850	18.450	1.295.272	
600	25.600	42.426	24.100	27.700	1.519.003	
600	33.500	45.680	37.030	25.526	1.564.017	
050	28.900	68.333	62.000	30.798	1.635.503	
936	27.790	72.425	65.900	39.411	1.698.011	

Table II.

Yield in Kroner of the different fisheries in the whole Limfjord 1890—1908.

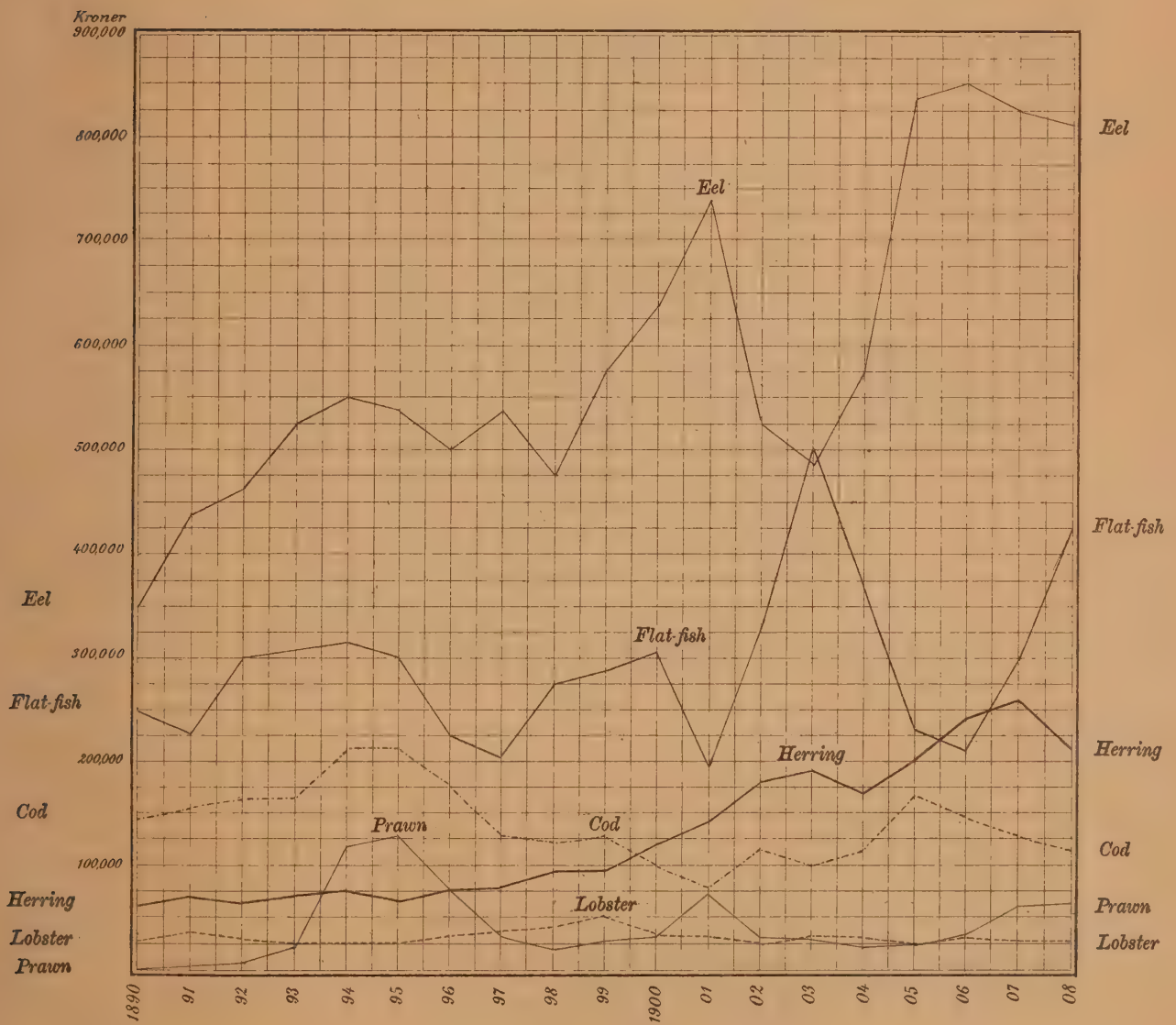


Table III.

Yield of the Flat-fish fishery in Divisions A, B and C,

in Kroner 1890—1908, in pounds 1898—1908.

Year.	A.	B.	C.	Total.	Total.	
				Kroner.	Pounds.	
1890	139.825	108.780	4.060	252.665		
1891	116.900	105.400	3.075	225.375		
1892	145.050	154.570	1.250	300.870		
1893	150.450	154.950	4.690	310.090		
1894	145.950	168.000	6.000	319.950		
1895	143.100	152.200	4.980	300.280		
1896	132.350	90.150	6.057	228.557		
1897	110.820	92.090	6.650	209.560		
1898	146.440	127.150	4.000	277.590	2.124.600	
1899	160.410	130.600	3.900	294.910		
1900	192.400	114.850	3.400	310.650	2.710.710	
1801	100.000	91.370	4.200	195.570	1.342.672	In the Fishery Reports there are several discrepancies between the totals and the sum of the different divisions, e. g. for $19^{02}/_{03}$ pg. 177.
1902	98.900	223.470	9.400	331.770	2.454.299	
1903	205.160	283.850	7.450	496.460	3.215.410	
1904	200.305	150.950	2.900	354.155	2.291.775	
1905	93.235	130.980	5.200	229.415	1.460.810	
1906	115.680	92.900	10.100	218.680	964.040	
1907	157.660	132.600	8.000	298.260	1.406.196	
Average	141.924	139.159	5.295	286.378		
1908	203.360	201.500	16.850	421.710	1.894.643	

Table IV.

Yield in Kroner of the Flat-fish fishery in Divisions A and B, Næssund-Feggesund, Hannæs- and Riisgaard-Louns Bredninger

(Plaice have been transplanted into all these 5 districts in 1908.)

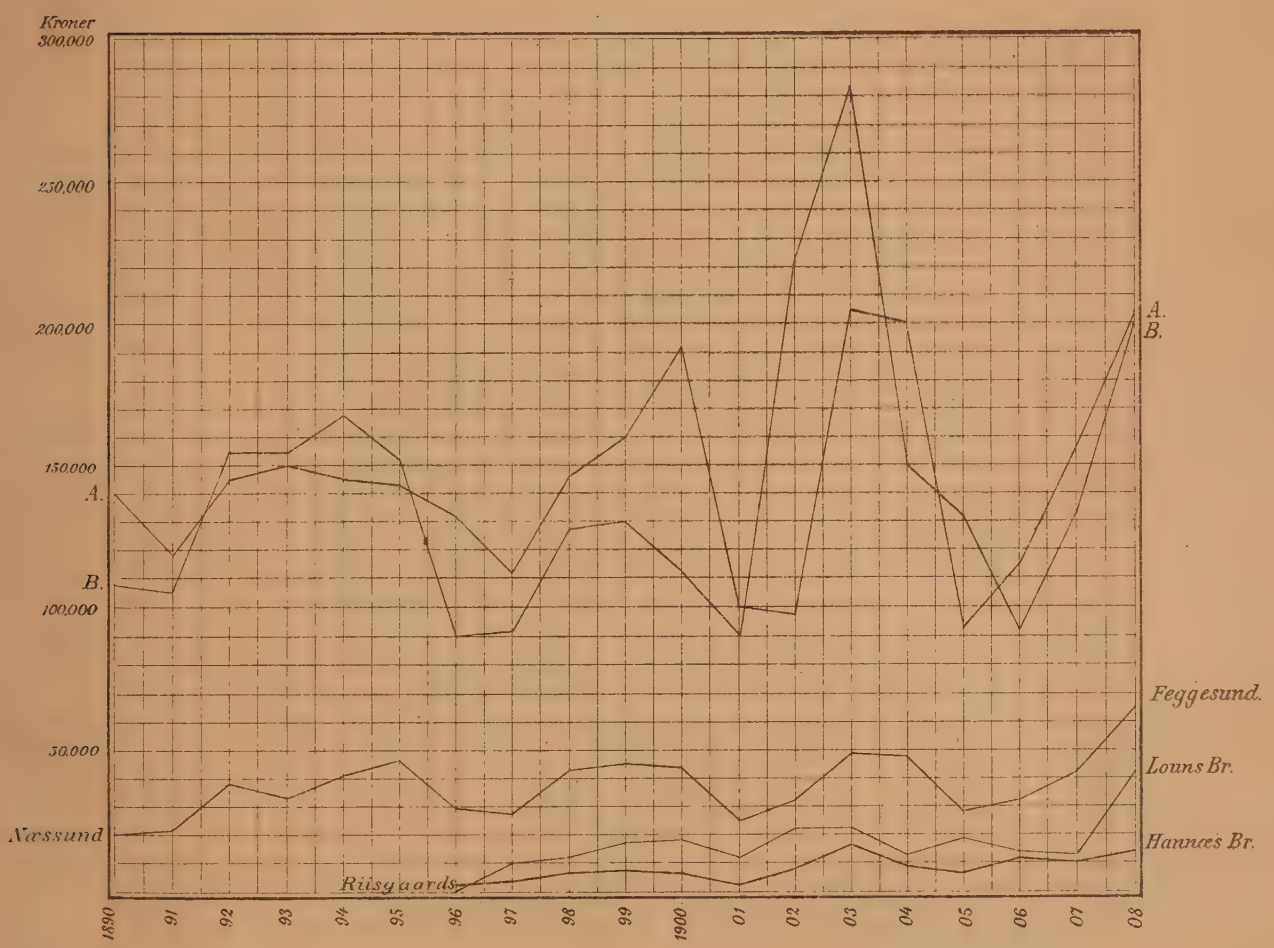


Table V.

Yield in Kroner of the Flat-fish fishery 1890(96)—1908 in the following localities of the Limfjord, to which plaice have been transplanted in recent years.

Year.	1. Næssund Feggesund (Thisted).	2. Riisgaard and Lovns-Bredning.	3. Hannæs-Bredning (Løgstør).	
1890	20.245			} Average yield for these two years ca. 21.000 Kr.
1891	21.800			
1892	37.850			
1893	34.150			
1894	41.200			
1895	45.600			
1896	29.000	800	2.400	
1897	27.000	10.380	4.200	
1898	42.840	13.200	5.200	
1899	44.560	17.400	7.000	
1900	44.000	17.250	5.400	
1901	25.040	10.770	3 500	
1902	31.850	22.270	6.500	
1903	48.590	22.150	15.500	
1904	47.365	11.900	7.300	
1905	27.225	18.550	5.700	
1906	32.580	13.700	10.800	
1907	40.960	14.400	9.900	
Average	37.488	14.398	6.954	
1908	65.260	42.400	14.500	

Table VI.

Yield in Kroner of the Flat-fish fishery in the Limfjord west of Løgstør, according to the statistics 1896—1908.

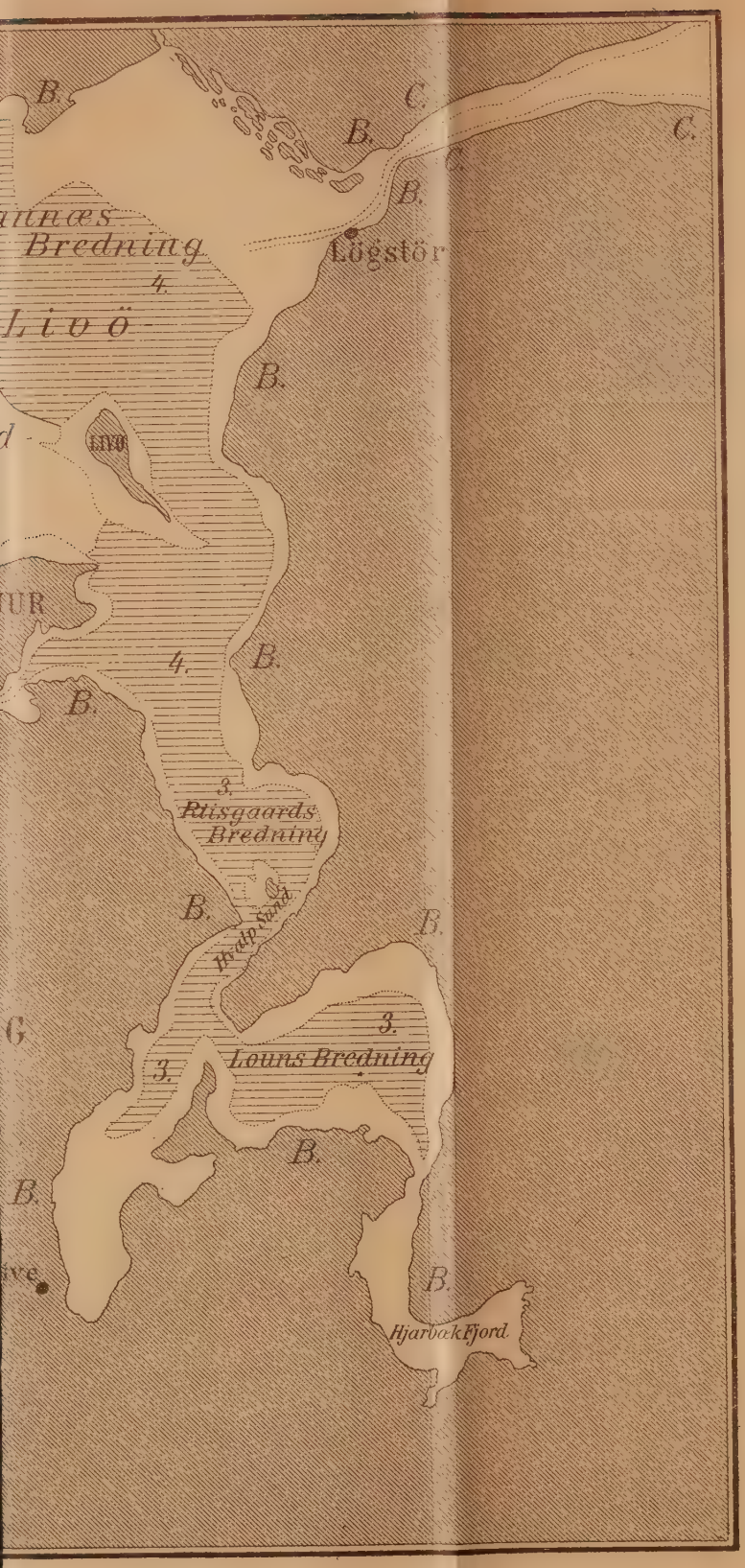
(Fishing places.)

Plaice have been transplanted into 2, 3 og 4, especially in 1908, but never into 1.

Year.	1. Thyborøn Nykøbing.	2. West and N. of Mors (Thisted).	3. Riisgaards and Louns Bredning.	4. The whole of Livø Bredn. N. of Salling.	Total (rounded).
1896	139.175	29.000	800	53.525	223.000
1897	119.320	27.000	10.380	47.410	204.000
1898	117.600	42.840	13.200	102.150	276.000
1899	150.650	44.560	17.400	81.800	294.000
1900	171.950	44.000	17.250	76.250	309.000
1901	98.360	25.040	10.770	60.400	195.000
1902	152.050	31.850	22.270	121.200	327.000
1903	222.470	48.590	22.150	203.250	496.000
1904	203.240	47.365	11.900	91.250	354.000
1905	135.610	27.225	18.550	47.330	229.000
1906	114.900	32.580	13.700	57.400	218.000
1907	165.300	40.960	14.400	76.800	297.000
Average	149.219	36 751	14.398	84.897	285 000
1908	200.600	65.260	42.400	112.000	420.000
Increase 1908 ..	51.381	28.509	28.002	27.103	135.000

CHART OF A PORTION OF THE

LIMFJORD.



EXPLANATIONS.

3 fathoms curve.

Areas with transplanted plaice.

— without — —

mixed region (Livø Bredning).

Within this boundary, i. e. in area R. in Nissum Bredning, the plaice young were taken in 1908.

A, B and C: the 3 divisions of the statistics.

1—4: the altered statistical divisions.

Transplantation experiments in 1908:

Div. 1.	*The western district none.*		
— 2.	*Thisted and Visby Bredning*	*ca. 18,800 Tdr. Land,*	*ca. 18,400 sc.*
— 3.	*Riisgaard and Louns —*	*ca. 14,200 - -*	*, ca. 15,200 sc.*
— 4.	*Whole of Livø Bredning N. of Salling, Area inplanted*	*ca. 35,400 - -*	*, ca. 36,000 sc.*
			Total ca. 696,000

or ca. 1,392,000 plaice.

The yield of these transplantation experiments in 1908 is given as between 100,000 and 150,000 Kr

Scale in miles.

0 1 2 3 4 5.

II.

Biological investigations on the stock of plaice in the Limfjord.

With 3 tables.

By

C. G. Joh. Petersen.

We can also employ another method than the statistical in order to obtain good information regarding the stock of plaice in the Limfjord, namely, by purely biological investigations and fishing experiments. Such fishing experiments have already been undertaken in earlier years, 1895, Report VI from the Biological Station; I may especially refer to Tables I and II in the above Report. Owing to the fact that the method of determining the age of plaice by means of the otoliths was not then known, the age of the plaice was not always correctly indicated. Numerous investigations made by means of this method are now to hand from the whole of the Limfjord. The best plan would certainly be, if in our fishing experiments with the one or the other apparatus we could fish out a definite area, e. g. 1 Td. land, in all the different parts of the fjord and take all the plaice up for investigation which were found on such an area; we could then see exactly how many, how large and how old the plaice everywhere were, and in the course of the year follow their growth. Such an ideal apparatus does not exist however as yet; either the ground is uneven and more or less easy to fish over, or the many plaice gill-nets in position offer a serious hindrance to such an investigation; this latter difficulty is very much felt in the Limfjord, as in many waters from Oddesund to Livø the gill-nets are practically everywhere throughout the whole milder part of the year. We are obliged therefore to fish between them or go right out to one side in the water; but in this way we do not always obtain typical samples. Something nevertheless has been attained, especially as I have found that the German eel-trawl without arms, provided with otter-boards and with long lines between these and the trawl, is a remarkable good fishing apparatus for all sizes of plaice, taking at the same time right down to 5 cm. in length or perhaps even smaller; by means of this apparatus we are thus able at one time to take all year-groups and thus to obtain a fair picture of their relative abundance on the area fished over. Hitherto I have been obliged to use several different kinds of net in investigating each locality for plaice, some with large meshes to catch the large, others with small meshes to take the small; to combine these catches later is simply impossible. The small-meshed nets also have a peculiarity of avoiding the large fish, because they must necessarily be towed slowly, and that the large meshes could not take small fish is naturally obvious; experiments with such apparatus were therefore a great waste of time and incomplete.

Investigations with the eel-trawl are now however to hand from the western fjord for the period 14 Sept.—10 Oct. 1908. The measurements and age-deter-

minations were carried out by stud. mag. H. Blegvad. The hauls with this net are given on Table A. The localities on the table are arranged from Thyborøn in towards the fjord. We see at once that small plaice under 10 cm. are taken here in large quantities in Nissum Bredning and Venø Bugt, some also in Kaas Bredning and in Sallingsund at Glyngør, but none in Livø, Riisgaard or Thisted Bredninger; in the latter, where large numbers of plaice were inplanted in 1908, we find on the other hand very large plaice, much larger than in the western Bredninger; but the number of these large plaice is but small. For by means of this trawl we also obtain some notion of the number of plaice per square unit of ground; not the absolute number, as many are passed over by the trawl, but a comparison of the density of the stock at different places is quite possible. In Nissum Bredning for example 256 plaice were fished in 20 minutes on Sept. 11, in Kaas Bredning in 3 hauls of 10 minutes each on Oct. 9th 210 plaice were caught and in Venø Bugt on the same day in 2 hauls of 10 minutes 67 plaice; this gives per 10 minutes haul respectively 128, 70 and 33 plaice, and as we fished to a great extent always with the same speed (almost the same number of turns of the screw), these numbers give for the western part of the fjord some conception of the density of the plaice there. In Livø, Riisgaard and Thisted Bredninger the Table shows that the hauls of 10 minutes only give numbers which vary from 1—7 plaice, thus, that the number of plaice decreases considerably in towards the fjord, but the size on the other hand increases. We learn further from the table, that small plaice under ca. 17 cm. are practically wanting in the inner Bredninger, and from this it follows that the plaice does not spawn in them; since also mature plaice (with exception of a few males) are practically unknown in the western Bredninger, and the pelagic eggs are also unknown, it follows that the small plaice (0-group, in the autumn of ca. 5—ca. 10 cm.) must also here have developed out in the North Sea and have migrated in as small later. The whole stock of plaice in the fjord must therefore be recruited from without through the Thyborøn Channel. That some should come from the east is quite excluded on account of many conditions which need not be closely discussed here. We might now imagine that the great difference in the size of plaice from west to east is due to this, that they become older gradually as they migrate into the fjord, and thus that the plaice at Livø and Thisted were older than the plaice of Thyborøn; but the age-investigations by means of the otoliths which have been carried out (see Table B) show, that this is not the case; the two youngest year-groups, 0 and I, are certainly wanting in Thisted Bredning, because they neither migrate in nor are transplanted, but the other plaice have just the same age as those at Thyborøn, namely 2—5 years. The two last columns on Table B show immediately how much these fish grow from spring to autumn. The two first colums of the same table show on the other hand, that the plaice at Thyborøn (Nissum Bredning) hardly grow at all.

We might think it remarkable, that we nowhere find plaice in the Limfjord which are over ca. 5 years and as a rule only fish of 3—4 years, as also that by far the most of them have not reached to the age of maturity; this is only reached by a few males and some of the largest females. The explanation of this is simply, that in the inner Bredninger they do not get time to grow up

Table A.

Plaice taken with the **eel-trawl** in the Limfjord 1908.

Length in cm.	Nissum Bredning.	Venø Bugt.	Kaas Bredning.	Sallingsund.	Livø Bredning.			Riisgaard Bredning.			Thisted Bredning.	
	Off Helligsø tile works.	Off Nygaards Hage.		S.W. of Glyngøre. 7 fms.	E. of Feggeklit.	W. of Livø.	N. of Eierslev Røn.		Hvalpsund.	E. N. E. of Lunget church.	N. of Hanklit.	Near Hanklit.
	2 hauls of 10 mins.	2 hauls of 10 mins.	3 hauls of 10 mins.	2 hauls of altogether 35 mins.	2 hauls of altogether 30 mins.	3 hauls of 10 mins.	6 hauls of 10 mins.	2 hauls of 10 mins.	3 hauls of 10 mins.	2 hauls of 10 mins.	3 hauls of 10 mins.	8 hauls of 10 mins. 1 haul of 15 mins.
	14. Sept.	9. Oct.	9. Oct.	6. Oct.	6. Oct.	10. Oct.	10. Oct.	11. Sept.	11. Sept.	7. Oct.	12. Sept.	6. and 7 Oct.
2												
3												
4												
5	3											
6	4											
7	18	1										
8	4	9	1									
9		10	2	4								
10	1	11	2									
11	21	5	2									
12	38	3										
13	29	1										
14	12		2									
15	6		7									
16	3	2	8									
17	15	3	12	1								
18	20	4	6	1								
19	9	6	18	2								
20	14	2	18	4		1						
21	21	1	20	2								
22	12	2	30	2								
23	11	2	16	5								
24	12	2	16	4	3							3
25	2	1	22	8			1				1	
26	1	2	9	3			1					
27			9	4			3		3		3	1
28			4	6				2	4		4	1
29			2	5	2	1	4		2	1	3	7
30			2	1	1		5	1	3	1	4	10
31				1	3	1	3	1	4		4	8
32			1	1	3		4			1	3	11
33			1		1		1	1				7
34					1		3	1		1		5
35						1	1			1		4
36												2
37							1			1		
38												1
39												1
40												1
	256	67	210	54	14	4	27	6	16	6	22	62
Number of plaice per 10 min.	128	33	70	13	5	1	5	3	5	3	7	6 à 7

Table B.

Age and size of plaice at differer

Total length in cm.	Nissum Bredning.																									
	Small-meshed, green seine and »Snurrevaad«.										»Snurrevaad« on otter-boards.										»Snurrevaad« on otter-boards.					
	4.—30. April.										13. October.										8. April.					
	I		II		III		IV		V		I		II		III		IV		V		II		III		IV		V	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
5	1																									
6	21	10																								
7	29	25																								
8	5	7																								
9		3																								
10																										
11				2																						
12			2	4	1						1	1														
13			1	3	1	1					3	1														
14			·	6	4	3					3	2										1				
15			·	3	7	4		1				3	2	2								·				
16			2		12	4		4					·	1							1	1				
17					18	10	5	1					2	·		1					3	4				
18					8	10	6	7					2	4		·					2	4		3		
19					5	5	9	11	1				1	2		1						1	1	4	1	1	
20					1	2	13	12	1	2				·	1	·						·	4	·	·		
21							10	16	1	2				1	1	3						5	2	·	1		
22							3	9	2	1					·	3	1					5	7	·	2		
23								3	·	·					2	1	·	1				3	1	3	4		
24								1	1	·					·	·	1	2				4	2	4	3		
25								·	1	1					1	1	4	·				1		2	3	1	
26								·	1	·						1	4	1					1				
27								·	1	·							1	1	1							1	
28								1		1																	
29																										
30																										
31																										
32																										
33																										
34																										
35																										
36																										
37																										
38																										
39																										
40																										
	56	45	5	18	57	39	46	66	9	7	7	7	7	10	5	11	11	5	1		6	11	20	23	10	14	1	1

The straight line across the table between 25 and 26 cm. indicates the usual limit betwee

ıt places in the Limfjord 1908.

ıaas Bredning.										Thisted Bredning.											
3 hauls with eel-trawl of 10 mins.										»Snurrevaad«.						3 hauls with eel-trawl of 10 mins.					
9. October.										27. April.						6.—7. October.					
0		I		II		III		IV		III		IV		V		II		III		IV	
♀		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂	♂	♀	♂	♀	♂	♀	♂	♀
1	1																				
1	1																				
1	1																				
	1																				
		1	1																		
		1	3																		
		1	2																		
		1	2																		
		1	1																		
		1	2							1											
				1						·	1	·	2		1						
				5	1					·	2	2	2		·						
				2	·	1				·	1	1	1		·						
				3	·	·				·	1	1	2	2	·						
				1	·	·				·	1	1	1	1	·						
				1	2	1				·	2	1	2	·	·						
				1	2	·	1			1		1	1		2						
				·	1	5	3									1					
				1		5	1	1	1							·	1				
						1	3									·	1	2	2	2	1
						1	1									·	·	2	1	1	·
						·	·									·	1	1	2	2	2
						1	·		1							1		1	1	1	2
																					·
																					·
																					1
3	4	4	13	15	7	16	10	1	2	2	10	5	11	3	3	2	4	6	15	10	11

ı undersized and standard plaice.

Table C.

Total length in cm.	Nissum Bredning.									
	Entrance to the fjord.	S. of Røjens Odde.	Entrance to the fjord.			S. of the entrance.	N. of Rønnen.	E. of Rønnen.	N. of Kamstrup Røn.	On t fjor groun
	S Sk.	S Sk.	S Sk.	S S.	S.	S.	S.	S.	S.	S Sl
	20 mins.	20 mins.	20 mins.	15 mins.	1 haul.	1 haul.	1 haul.	1 haul.	(2 hauls.)	10 mi
	3. April.	4. April.	6. April.	7. April.	22. April.	22. April.	22. April.	22. April.	23. and 30. April.	24. Ju
3										
4										
5				1						
6		1		30						
7				54						
8				12						
9				3						1
10				·						2
11	3		1	2	1			1		2
12	7	2	1	4	2	1		·	3	2
13	7	3	2	3	8	5	2	·	3	1
14	22	14	2	8	5	5	2	1	2	3
15	32	42	7	5	15	8	17	12	11	5
16	43	56	26	6	15	23	24	29	29	17
17	48	67	36	13	12	36	29	32	38	21
18	49	73	33	6	11	31	17	26	38	34
19	49	50	27	10	9	32	17	28	43	34
20	35	39	24	6	20	31	15	27	54	25
21	37	19	15	1	12	18	8	14	42	51
22	17	15	10	1	10	9	8	6	17	44
23	14	5	8	·	7	6	2	2	5	25
24	15	5	4	·	7	4	2	3	4	23
25	8	1	10	·	9	5	1	1	3	11
26	7	3	1	·	2	2		1	2	2
27	3	5	4	1	1			1	1	5
28	·	2	2	2	1			1		1
29	1		1		·					
30	1		1		1					
31			1							
32										
33										
34										
35										
36										
37										
38										
39										
40										
Number measured:	398	402	216	168	148	216	144	185	295	30
Total catch:	620	520	538	168	1800	1600	700	617	1532	11
Weight of standard plaice per score:										

S = Snurrevaad, 300 fm. Line. S Sk. = Snurrevaad on otter-boards. S S. = small-meshed, green

Plaice. Limfjord 1908.

Venø Bugt.					Kaas Bredning.		Sallingsund.			Livø Bredning.					
N. of Venø.	E. of Venø.	S.E. of Venø.	E. of Venø.		Kaas Bredning.		Lysø Bredning.		S.W. of Glyngøre	N. of Fur.	Løgstør Bredning Nord.	E. of Holmeflak.	E. of Feggeklit.		Bet Fur Li
S.	S Sk.	S.	S Sk.	Eel-trawl.	S Sk.	Eel-trawl.	S.	Seines.	Eel-trawl.	S.	S.	S Sk.	Gill-nets.	Eel trawl.	Gill
(2 hauls.)	15 mins.	1 haul.	2×10 mins.	2×10 mins.	20 mins.	3×10 mins.	1 hanl.		15 and 20 mins.	(2 hauls.)	(3 hauls.)	2×5 mins.		10 and 20 mins.	
25. April and 1. May.	8. April.	24. April.	23. July.	9. Oct.	8. April.	9. Oct.	13. April.	6. Oct.	6. Oct.	15. and 28. April	25. April.	3. Aug.	6. Oct.	6. Oct.	10.
				1											
				9		1									
				10		2			4						
				11		2			·						
				5		2			·						
				3		·			·						
				1		·			·						
1			1	·	1	2			·		1				
4			2	·	4	7			·		·				
9			2	2	18	8			·		5				
15		1	2	3	30	12			1	1	4				
24		·	7	4	23	6	1		1	3	13				
27	1	1	3	6	25	18	3		2	3	9				
39	5	7	5	2	22	18	6		4	2	6				
42	1	5	12	1	35	20	6		2	2	6				
45	7	18	14	2	47	30	7		2	·	5	1			
30	9	24	13	2	40	16	16		5	1	4	2			
7	14	27	13	2	44	16	21		4	4	2	4		3	
7	10	23	28	1	21	22	10	4	8	3	1	2		·	
3	8	14	21	2	1	9	5	6	3	1	2	4		·	
	1	·	7		2	9	1	3	4	1	4	2		·	
		3	7		1	4	·	4	6	·	1	1		·	
		·	·			2	1	2	5	·		2		2	
		1	1			2		1	1	·		1	3	1	
			1			·			1	·		·	6	3	
						1			1	1		1	1	3	
						1							4	1	
													1	1	
													1		
253	56	124	139	67	314	210	77	20	54	22	63	20	16	14	4
253	56	124	142	67	314	210	77		54	22	63	21		14	
								9 Pd.	10 Pd.				$15^1/_2$ Pd.		13^1

		Louns and Riisgaard Bredning.						Thisted Bredning.						
N. of Livø.	N. of Eierslev Røn.	Louns Bredning.	Riisgaard Bredning.	Hvalpsund.	Riisgaard Bredning.	E.N.E. of Junget Church.	Hvalpsund.	N. and N.N.E. of Hanklit.	N. of Hanklit.	NNE. of Hanklit.	N. of Hanklit.	Near Hanklit.	Thisted Bredning	
Eel trawl.	Eel trawl.	S.	S.	Eel-trawl.	Eel-trawl.	Eel-trawl.	Gill nets.	S.	S Sk.	S Sk.	Eel-trawl.	Eel-trawl.	Bought.	Bought.
3×10 mins.	6×10 mins.	1 haul.	(2 hauls.	3×10 mins.	2×10 mins.	2×10 mins.		(2 hauls.)	2×10 mins.	30. mins.	3×10 mins.	8×10 mins. 1×15 mins.		
10. Oct.	10. Oct.	14. April.	14. and 29. April.	11. Sept.	11. Sept.	7. Oct.	8. Oct.	27. April.	27. June.	20. July.	12. Sept.	6. and 7. Oct	6. and 7. Oct.	24. Nov.
			1					1						
			1					1						
			4					1						
		1	1					3						
		1	2					4	1					
1		1	2					6	·					
·		·	3					4	·					
·		1	2					5	1	3				
·		1	3					4	1	1				
·		1	4					4	2	2		3		
·	1	1	1					2	1	1	1	·		
·	1	·	1						1	9	·	·		
·	3	1	1	3					3	6	3	1		
·	·		1	4	2				2	4	4	1		
1	4		·	2	·	1			1		3	7	2	1
·	5		1	3	1	1	7				4	10	16	5
1	3		·	4	1	·	9				4	8	35	21
·	4		1		·	1	11				3	11	36	34
·	1		·		1	·	8					7	24	39
·	3		1		1	1	4					5	29	36
1	1		1			1	4					4	16	18
	·		·			·	3					2	8	22
	1		1			1	1					·	3	14
												1	2	9
												1	·	1
												1	1	
4	27	8	32	16	6	6	47	35	13	26	22	62	172	200
4	27	8	32	16	6	6		35	13	26	22	62		
	14 Pd.						16 Pd.						$17^{3}/_{4}$ Pd.	

large but are fished up, and that in Nissum Bredning they presumably either migrate inwards and are fished up or migrate out and disappear in the North Sea, The stock ef fish in Nissum Bredning is therefore to be considered as consisting of 5 year-groups of plaice, which for a time remain at this spot but in reality do not belong there for always. There are plaice in Nissum Bredning at all periods of the year, at any rate from March to December, as this matter has been investigated; but they are certainly not present always in the same quantities, though this may come from the fact, that the plaice sink deep into the bottom and are not so easily fished in the cold period of the year; naturally a no small migration of the plaice out and in through the Channel occurs, of all the sizes which at all are found in Nissum Bredning, but we must not, as is often done, imagine that many plaice can be found in Nissum Bredning during the "period of immigration", in March—April.

Table C gives information on the size of the plaice at different times of the year in different Bredninger. It will be seen how constant the size remains in Nissum Bredning from April—September, but on the other hand how much the plaice grows during the same period in Livø, Louns and Thisted Bredninger; Venø Bugt, Kaas Bredning and Sallingsund represent an intermediate stage, where the growth is only moderate.

The hauls shown on Table C have been carried out with different apparatus, thus "snurrevaad", partly with lines and in the usual manner, partly with otter-boards, with small-meshed "snurrevaad" and with eel-trawl; where it was difficult to fish, sometimes fish have been bought from the fishermen for comparison of their size. The table shows distinctly the, in number, large catches to the westwards, up to 16—1800 plaice per haul, with some few specimens in the inner Bredninger. I am obliged to believe, as I have already shown earlier, that the great growth of the plaice in the inner Bredninger is just connected with the fact, that there are here so few fish per Td. land, but whether the conditions of the bottom also have some influence on this result must be more closely investigated in the future.

III.

The yield of the prawn fishery from 1885–1907 and its improvement by means of protection.

With 3 tables.

By

C. G. Joh. Petersen.

In 1897 appeared Dr. phil. Th. Mortensen's "Undersøgelser over vor alm. Rejes Biologi og Udviklingshistorie samt Bemærkninger om Rejefiskeriet i de danske Farvande", published by the "Dansk Fiskeriforening", investigations which were for the most part carried out in the Limfjord on the Biological Station and with its help. Dr. Mortensen maintains that the reasons for the decline in the prawn fishery must be sought for first and foremost in the intense fishery which was being carried on, especially in the spawning time of the prawn and especially after the large, valuable females. He ends with recommending a close time in June or a portion of June as means for the improvement of the prawn fishery.

His main evidence for the necessity of closure to again raise the fishery is based on the statistics, which he could show up to the year 1895 both for the Limfjord and for outside, and which just at that time displayed a very strong decrease in the waters within the Skaw and a great increase in the Limfjord, in which fjord the fishery for the prawn had only then begun and was in process of being destroyed. Great objection was made by fishery circles against his advice with regard to closure, and very little has been done in the matter even yet; it might therefore be of interest to see how the prawn fishery has gone on during the 12 years which have passed since then, as I shall endeavour to do here. On Table D the yield of the prawn fishery in the Limfjord from 1890—1907 is shown; for the years 1896—1907 the statistics have been taken from the Fishery Reports; for the years 1890—1895 Dr. Mortensen's "Undersøgelser" p. 61 have been used; to these is added a column showing the yield by weight (pd.); for the years 1890—1895 this weight has been calculated on the basis of the prices for 1896, according to which 1 Krone corresponded approximately to 1.7 lb. The prices have namely altered so much in the course of the years, that the monetary yield gives but a bad representation of even the extent of the fishery.

On Table E the yield of the prawn fishery is given in pots, pd. and Kroner from 1885—1907 for the different, large waters within the Skaw, according to the Fishery Reports. The years 1898—1903 contain the data in pots as well as lbs.; o obtain comparable material, 1 pot is here reckoned to be equal to 1.5 lb. Various data in the Fishery Reports make it probable, that this equivalent is fairly right for the whole country; but it varies for the rest somewhat in the different parts.

Table F finally gives two curves, which on the basis of Tables D and E give the yield of the prawn fishery in the Limfjord in lb. and for the waters

within the Skaw in pots for the different years. It need only be added, that the prawn fishery of the Limfjord was quite insignificant before 1890.

Consideration of these curves shows, that in 1885—1887 the prawn fishery within the Skaw was flourishing, with a yield of 3—400,000 pots yearly, then follow 2 bad years; then again a prosperous period for a couple of years, though far from as great as previously; and from 1892 follows a series of bad years till 1900; then come 4 relatively good years, though the average take in pots was not half as great as the yield in 1885—87. On the other hand, the prices in recent years have gone up so much, that the monetary yield in bad years now far exceeds that in the earlier good years (see Table E). The second curve on Table F for the Limfjord shows, that when the yield within the Skaw became bad in 1892—93, the Limfjord which had previously been untouched began to be exploited; it took only 3 years, 1894—96, to fish this out. In 1898—1900 the yield is very far down, so that the whole prawn fishery almost ceased; then the yield rises in 1901, but soon falls again. As the tables and curves show, the fluctuations in this fishery have been enormous and it has never become again what it was when the intense fishery began, and we can certainly not expect to get it to increase permanently, at least not without long and persistent protection. That it is mainly the fishery which produces the constantly downward-going, main tendency, I must consider like Dr. Mortensen to be proved beyond doubt. There are indeed fluctuations in all production of this kind, but fluctuations came in the beginning at the same time as the development of the fishery. When a bad yield occurs owing to lack of sufficiently many prawns, a natural kind of protection, so to speak, occurs of itself, as most of the fishermen then go over to another fishery; when such a closure has lasted a couple of years, prawns grow quickly and the fishery is again on the upward grade, to be followed again by a descent. Such has happened both in and outside the Limfjord.

The apparatus which has taken the most prawns is the prawn-trap; these are used in thousands in the country. In the Limfjord in 1894 only 266 of these were used, but in 1895 ca. 1200 traps and in 1896 certainly still more; if we should think of introducing the closure we must therefore direct our attention specially to the prawn-traps.

The monetary yield of the prawn fishery is by no means certainly a very great thing on which the existence of many people is dependent; since the good period in 1895 and up to the present it has varied in the Limfjord between 130,000 Kr. and 20,000 Kr. and in the other waters between 170,000 Kr. and 50,000 Kr.; in comparison with our eel and plaice fisheries it must therefore be considered as small, as the yield of these amounts to millions; but just for this reason we could the more easily defend the experiment of protecting the prawn in waters where such could be considered to give good results, e. g. in the Limfjord or Isefjord, I would only advise against experimenting with too restricted waters, as the prawn certainly migrates out of these and it is therefore not certain that a too restricted closure will give the result, a flourishing and more constant prawn fishery.

It is often maintained that it is not only man who seeks for the prawn, but also animals such as cod, eel and sea-scorpions eat them and ice in winters might kill them; it is certainly quite correct that the prawn must also pay some

toll in this regard, but I have no doubt that the prawn-trap is nevertheless the worst enemy of the prawn; every one who has followed the development of the prawn fishery since 1885 and seen how it flourished and quickly went back at the different places one after another, first in Roskilde Fjord (Roskilde prawns), later at Holbæk, in the waters south of Sealand and south of Funen and lastly in the Limfjord, will have no doubt about the matter. Dr. Mortensen wrote about it already in 1895, the last 12 years have given him support in the main.

Such protection can be carried out in the Limfjord with respect to the § 40 of the Fishery Laws, and outside this by making bye-laws; but the fishermen themselves should take the initiative in this matter and I would strongly recommend them to do so; many of them are indeed convinced that it will help.

We can hardly expect that the closure will lead to a constant yield so large as it was in the old, best years of all, but the great loss when the fishery goes down to $^1/_{10}$th of what it was could be avoided and this in itself would be much. Such protection would in the first place prevent the migrating female prawns being almost all fished out. We might therefore think it best to enforce the closure on traps during the period of migration, which certainly is somewhat different in different years and in the different waters, but lies within the months of May, June and July, and we might, if we did not wish a continuous long period of closure, e. g. 4 weeks, choose parts of these months or even certain days of the week, so that some of the females at any rate might slip out and spawn. The longer the period of closure the more distinct would be the results we should expect, and as the prawn grows up in $1^1/_2$—2 years, we should not have long to wait for the result. With the enormous prices paid for prawns in later years, especially in Copenhagen, 3—4 times higher than in 1886, a splendid return could certainly be obtained without great sacrifices.

In the above mentioned paper Dr. Mortensen points out that for want of the ordinary prawn, the "horse-prawns", "sand-horses" *(Crangon vulgaris)* or whatever they may be called, which are so much appreciated in other countries, might also be used; they are called Garneelen, Nordseekrabben and shrimps in other countries. This advice of his has not been followed; but I consider it good nevertheless, especially under the present conditions when the ordinary prawns are hardly to be procured. The large Norwegian prawns *(Pandalus borealis)* which are now sold in Copenhagen, after they had been proved to occur in abundance by Dr. Johan Hjort's and my investigations in Kristiania Fjord, among other places just off Kristiania in deep water, do not seem able to be a good substitute for our common prawns; I would almost believe that our gray-red shrimps might become this, when the fishery for them is carried on in the right way; and there are many of them at certain places in our waters.

Table D.

Statistics of the Prawn fishery in the Limfjord

from 1890—1907.

Year.	A. Western Part.		B. Central Part.		C. Eastern Part.		Total	
							Weight.	Value.
	Pd.	Kr.	Pd.	Kr.	Pd.	Kr.	Pd.	Kr.
1890	»	305	»	350	»	240	ca. 1.520	895
1891	»	765	»	1.600	»	600	» 5.000	2.965
1892	»	7.095	»	2.000	»	215	» 15.800	9.310
1893	»	12.200	»	2.600	»	160	» 25.400	14.960
1894	»	104.150	»	13.600	»	700	» 200.000	118.450
1895	»	106.550	»	22.000	»	795	» 220.000	129.345
1896	112.000	62.500	21.700	16.050	555	543	134.255	79.093
1897	50.250	26.175	17.860	7.630	620	380	68.730	34.185
1898	29.000	14.600	3.891	2.290	3.620	2.310	36.511	19.200
1899	32.600	22.700	4.759	3.250	2.200	2.200	39.559	28.150
1900	20.700	20.700	5.874	4.700	5.800	5.900	32.374	31.300
1901	80.100	40.050	48.303	23.965	12.390	6.300	140.793	70.315
1902	46.700	23.350	13.460	6.730	8.750	7.050	68.910	37.130
1903	42.400	24.990	9.000	4.500	6.000	4.100	57.400	33.590
1904	30.400	15.200	5.899	3.550	2.100	2.100	38.399	20.850
1905	36.700	18.350	4.526	3.350	1.200	2.400	42.426	24.100
1906	34.600	28,080	10.530	8.400	550	550	45.680	37.030
1907	41.300	41.300	22.483	15.300	4.550	5.400	68.333	62.000

Table E.

Product and value of the Prawn f

from 1885—19

Year.	East coast of Jutland to the north.		to the south.		North coast of Sealand.		The Sound.		Great Belt.		Sout
	Pots.	Kr.	Pots.	Kr.	Pots.	Kr.	Pots.	Kr.	Pots.	Kr.	Pots.
1885	.....	.....	2.326	2.194	35.254	13.028	66.594	40.657	7.263	2.319	100
1886	.....	.....	10.206	4.809	31.239	12.722	177.497	39.775	37.294	6.830	200
1887	.....	.....	8.934	3.164	17.854	6.401	128.396	48.046	35.990	8.983	12.247
1888	.....	.....	1.170	723	4.621	2.457	47.687	30.299	5.851	2.613	1 650
1889	.....	.....	1.840	770	2.048	898	27.294	29.757	6.821	4.652	16.747
1890	.....	.....	920	431	2.111	1.618	26.108	28.435	1.994	1.313	18.767
1891	.....	.....	4.927	4.128	19.354	13.203	33.391	19.670	12,350	6 194	56.715
1892	.....	.....	6.411	3.854	5.469	4.565	16.882	16.697	3.723	2.779	55.708
1893	.....	.....	11.182	6.405	4.129	3.982	5.472	6.847	4.000	4.503	21.273
1894	.....	.....	11.435	7.341	4.107	3.998	5.252	5.345	1.861	1.140	23.832
1895	.....	.....	8.329	5.359	10.221	12.113	3 925	5.623	1.356	1.447	13.895
1896	.....	.....	13.052	7.864	9.239	14.646	5.584	10.994	1.194	1.448	26.071
1897	21	22	1.913	1.735	5.362	7.752	4.911	11.171	1.381	1.812	20.512
1898	.....	.....	2.199	2.297	3.118	11.955	2.830	13.793	1.500	3.506	3.158
Pounds	.....	.....	.....	.....	8.583		8.100		2.043		34.378
1899	.....	.....	11.001	9.223	173	13.983	4.762	11.753		1.829	31.871
Pounds	.....	.....	.....	.....	14.014		3.085		2.384		30.037
1900	.....	1.000	5.429	6.715	2.448	5.383	325	6.389		3.491	5.940
Pounds	1.000				1.176		3.308		2.325		21.293
1901	2.410	2.030	18.750	15.914	11.250	18.620	250	24.960	320	3.750	10.520
Pounds	20				9.560		30.430		5.310		39.920
1902	4.500	4.500	10.870	11.435	5.565	4.965	1.510	1.595	2.220	2.040	6.180
Pounds	.....	.....	.....	.....	8.655	8.510	21.275	23.270	3.615	2.510	61.650
1903	600	600	18.386	16.856	12.739	21.696	11.153	24.225	258	4.006	11.553
Pounds	.....	.....	.....	.....	10.650		25.898		5.155		66.302
1904	800	550	9.419	9.190	11.915	12.450	20.684	27.278	8.299	7.792	67.299
1905	2.083	1.763	8.753	9.683	8.749	12.696	9.664	12.197	3.914	3.897	28.857
1906	1.990	2.190	8.110	7.415	6.490	7.960	12.240	18.110	5.821	4.918	59 706
1907	2.900	3.800	2.820	2.860	5.940	6.730	15.270	20.850	1.820	2.040	20.020

ishery within the Skaw

)7.

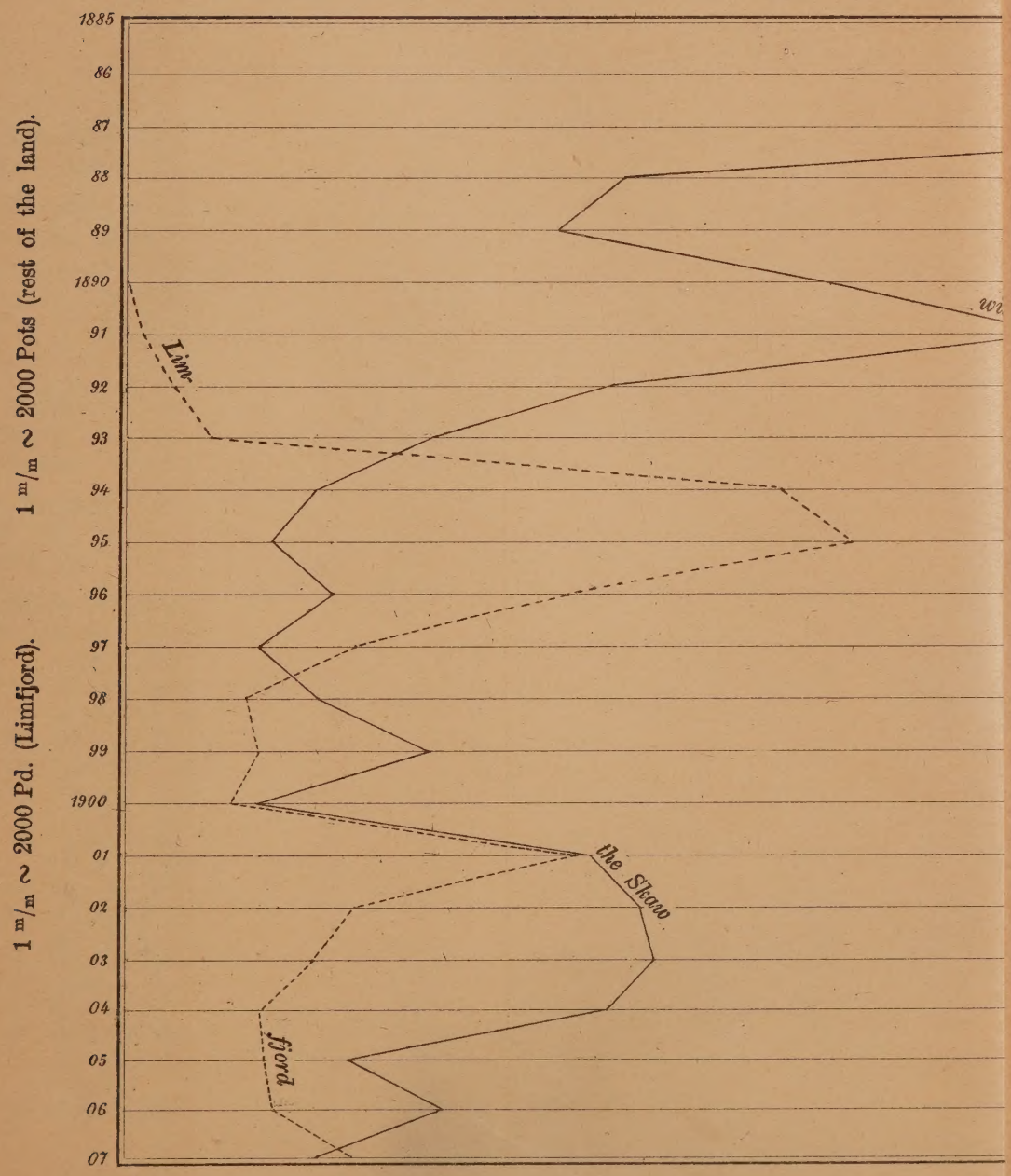
h Funen.		South Sealand.		South Lolland.		Total.			
	Kr.	Pots.	Kr.	Pots.	Kr.	Pots (and pounds).	Kr.	Pots.	
	100	159.491	45.111	12.864	5.025	283.882	108.434	283.882	
	330	133.570	53.049	18.812	5.449	408.818	122.964	408.818	
	2.330	157.645	52.580	25.755	5.899	386.821	127.403	386.821	
	1.088	62.072	33.382	29.016	8.576	152.067	79.138	152.067	
	6.820	54.728	26 567	22.917	9.221	132.393	78.685	132.393	
	11.082	59.116	50.544	106.353	46.695	215 369	140.118	215.369	
	10.458	70.680	37.632	87.969	35.386	285.386	126.671	285.386	
	21.809	24.940	24.219	34.773	22 933	147.906	96.856	147.906	
	15.513	31.640	39.117	15.655	13.035	93.351	89.402	93.351	
	29.435	9.731	10.198	1.271	1.717	57.489	59 174	57.489	
	16.729	5.057	8.367	2.532	3.052	45.315	52.690	45.315	
	31.996	4.481	5 859	3.960	5.547	63.581	78.354	63.581	
	29.406	3.101	5.936	4.461	5.781	41.662	63.615	41.662	
	28.630	3.495	10.815	1.262	3.685	17.562	74.681	57.876	
		4.317		3.050		60.471			$1_{,5}$ Pd. is taken as = 1 Pot.
	44.856	5.704	5.202	2.755	7.774	54.266	94.620	91.916	
		1.906		5.050		56.476			
	38.799	2.849	13.246	912	3.015	17.903	78.038	40.793	
		3.848		1.386		34.336			
	35.450	19.590	25.160	13.740	22.710	76.830	148.920	142.370	
		5.040		8.030		98.310			
	5.375	32.745	41.255	4.750	5.530	68.340	170.470	156.474	
	32.945	22.355	18.355	14.650	8.185	132.200			
	47.869	18.283	32.100	3.769	9.341	76.731	166.693	161.787	
		9.888		9.691		127.584			
	56.618	17.845	24 537	11.060	10.786	147.321	149.201	147.321	
	34.332	4.163	6.427	2.420	4.302	68.603	85.297	68.603	
	47.740	1.230	1.310	2.000	3.250	97.587	92.893	97.587	
	18.060	6.670	8.100	3.090	3.840	58.530	66.280	58.530	

Table F.

Graphic representation of the yield of th

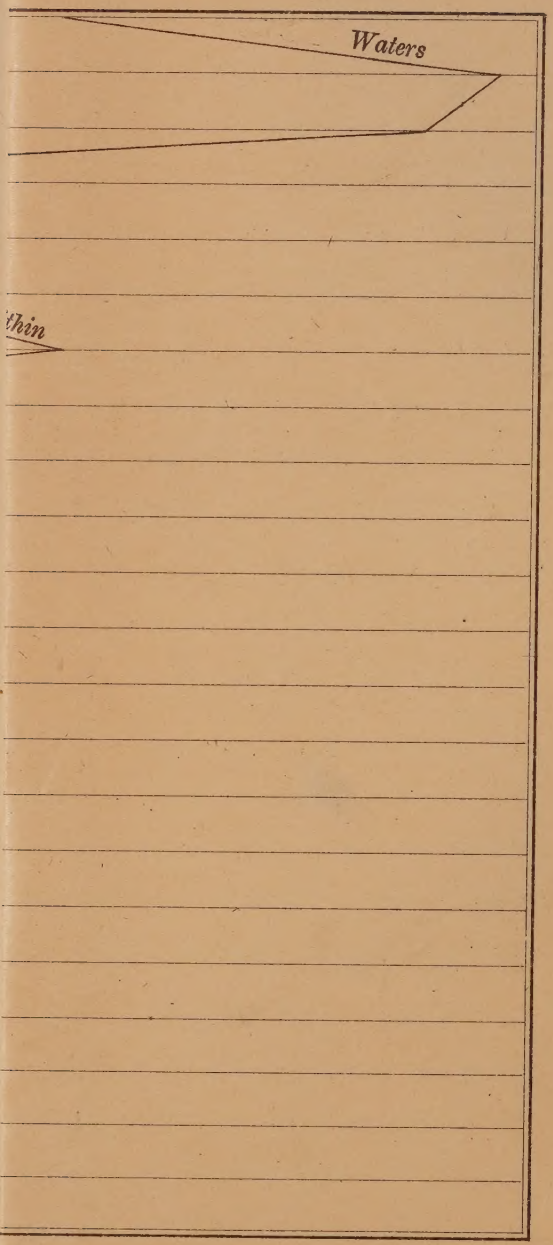
in (1) the Limfjord
and (2) waters within the Skaw { respectively

1885—1907.



e Prawn fishery

in } Pounds
Pots



C. G. Joh. Petersen: Om de skalbærende Molluskers Udbredningsforhold i de danske Have indenfor Skagen 1888. 8°. 1162 pg. 2 Kort.

Det videnskabelige Udbytte af Kanonbaaden »Hauch«s Togter i de danske Have indenfor Skagen. 1893. 4°. 464 pg. Atlas i folio.

Indhold: Echinodermata (Petersen), Diatomeer (Cleve), Undersøgelse af nogle Bundprøver (Rørdam), Mollusca (Petersen), Cephalopoda (Posselt), Crustacea malacostraca (Meinert), Hydrografi (Rørdam), Polyzoa (Levinsen), Ascidiæ simplices (Traustedt), Annulata, Hydroidæ, Anthozoa, Porifera (Levinsen), Nogle alm. Resultater (General Results. Engl.) (Petersen).

C. F. Drechsel: Oversigt over vore Saltvandsfiskerier med Kort og Planer. 1890. 4°. 100 pg. Med et Tillæg: »Om Naturforholdene indenfor Skagen« af *C. G. Joh. Petersen.* Med Kort. 4°. 46 pg.

Fiskeri-Beretning for 1888—89, 89—90, 90—91, 91—92, 92—93, 93—94, 94—95, 95—96, 96—97, 97—98, 98—99, 99—1900, 1900—01, 1901—02, 1902—03, 1903—04, 1904—05, 1905—06, 1906—07, 1907—08.

Beretning fra den danske biologiske Station I (1890—91)—XI (1900—1901) findes i de tilsvarende Fiskeri-Beretninger.

I. Fiskenes biologiske Forhold i Holbæk Fjord. 1890—91. 63 pg. Med et Kort.
II. Om vore Kutlingers (*Gobius*) Æg og Ynglemaade. 1892. 9 pg. Med 2 Tavler.
II. On the Eggs and Breeding of our Gobiidæ. 1892. 9 pg. Two Plates.
III. Det pelagiske Liv i Fænø Sund etc. 1893. 38 pg. Tabeller.
III. The Pelagic Life in Fænø Sound etc. 1893. 38 pg. Tables.
IV. Om vore Flynderfiskes Biologi og om vore Flynderfiskeriers Aftagen. 1894. 146 pg. 2 Tavler. 1 Kort og mange Tabeller.
IV. On the Biology of our Flat-fishes and on the decrease of our Flat-fish Fisheries. 1894. 146 pg. 2 Plates. 1 Chart. Many Tables.
V. Den alm. Aal (*Anguilla vulgaris* T.) anlægger før sin Vandring til Havet en særlig Forplantningsdragt. 1896. 35 pg. Med 2 Tavler.
Etc. 64 pg.
V. The common Eel (*Anguilla vulgaris* T.) gets a Particular Breeding-dress before its Emigration to the Sea. 1896. 35 pg. With 2 Plates.
Etc. 64 pg.
VI. Om Rødspætteyngelens aarlige Indvandring i Limfjorden etc. 1887. 49 pg. 1 Kort. 2 Tabeller.
VI. The Yearly Immigration of young Plaice into the Limfjord etc. 1897. 48 pg. 1 Chart 2 Tables.
VII. Plankton-Studier i Limfjorden. 1897. 23 pg. 1 Kort. 4 Tabeller.

VII. **Separat.** *C. G. Joh. Petersen:* Plankton Studies in the Limfjord. 1897. 23 pg. 1 Map 4 Tables.

VIII. Om et Skovl-Vaad til Undersøgelse af dybere Farvande. 1898. 24 pg. 10 Figurer.

VIII. **Separat.** *C. G. Joh. Petersen:* An Otter-Seine for the Exploration of Deeper Seas. 1898. 24 pg. With 10 Figures.

IX. Travlinger i Skagerak og det nordlige Kattegat i 1897 og 98. 1899. 56 pg. 1 Kort.

IX. **Separat.** Trawlings in the Skager Rack and the Northern Cattegat in 1897 and 98. 1899. 56 pg. With One Map.

X. Fortegnelse over Aalerusestader i Danmark etc. — Mindre Meddelelser. 1899 og 1900. 36 pg. Et farvetrykt Kort.

X. List of The "Aalerusestader" in Denmark, etc. — Smaller Communications. 1899 and 1900. 37 pg.

XI. I. Torskens Biologi i de danske Farvande. II. Om andre Torskefisk i vore Farvande. III. Nogle almindelige Betragtninger om Fredning, Lovgivning etc. IV. Ændringer og Forbedringer af Skovl-Vaad til zoologisk Brug. 1900 og 1901. 44 pg.

XI. I. The Biology of the Cod in the Danish Seas. II. On other Codfishes in our Seas. III. Some General Observations on Protection, Legislation etc. IV. Alterations and Improvements on Otter-seines for Zoological Purposes. 1900 and 1901. 44 pg.

XII. I. Hvor og under hvilke Forhold kunne Rødspættens Æg udvikle sig til Unger indenfor Skagen? 1 Kort. II. Smaahvarrernes (*Zeugopterus*-Slægtens) Unger. 1 Tavle. III. Kunne vi optage Konkurrencen med Udlandets Damptrawlere i vore Farvande udenfor det danske Søterritorium? 1902 og 1903. 36 pg.

XII. I. Where, and under what Conditions, can the Eggs of Plaice be developed into Young Fish within the Skaw? II. On the Young Stages of the genus *Zeugopterus*. (With one Plate.) III. Can we enter into Competition with the Foreign Steam-trawlers in our Seas outside the Danish Territorial Limit. 1902 and 1903. 33 pg.

XIII. Fiskeæg og Fiskeyngel i de danske Farvande. (Undersøgelser i 1904 og tidligere Aar. 1903 og 1904. 81 pg.

XIII. Eggs and Young of Fishes in the Danish Waters. (Investigations during 1904 and earlier years.) 1903 and 1904. 85 pg.

XIV. I. Om Lysets Indflydelse paa Aalens Vandringer. II. Om Aalens Alder og Vækst. 1906. 39 pg.

XIV. I. The Influence of Light on the Migrations of the Eel. II. Age and Rate of Growth of the Eel. 1906. 39 pg.

XV. Studier over Østersfiskeriet og Østersen i Limfjorden. Med et Kort, Temperaturkurver, 3 Tabeller og 2 Tekstfigurer. 1907. 70 pg.

XVI. Aalegræssets *(Zostera marina's)* Vækstforhold og Udbredelse i vore Farvande. 1908. 61 pg.

XVI. On the Ecology and Distribution of the Grass-Wrack *(Zostera marina)* in Danish Waters. (With 9 figures.) 1908. 62 pg.

XV and XVII. I. First Report on the Oysters and Oyster Fisheries in the Lim Fjord. (40 pg.) II. Second Report on the Oysters and Oyster Fisheries in the Lim Fjord. 1908. (24 pg.)

XVIII. I. Om Udbyttet af Limfjordens Fiskerier i de senere Aar samt om Rødspætteindplantningen i 1908. Med 6 Tabeller og 1 Kort. II. Biologiske Undersøgelser over Limfjordens Rødspættebestand. Med 3 Tabeller. III. Om Rejefiskeriets Udbytte fra 1885—1907 og om dets Forbedring ved Fredning. Med 3 Tabeller. 25 pg.

XVIII. I. The Yield of the Limfjord fisheries in recent years and the transplantation of plaice in 1908. With 6 tables and 1 chart. II. Biological investigations on the stock of plaice in the Limfjord. With 3 tables. III. The Yield of the Prawn fishery from 1885—1907 and its improvement by means of protection. With 3 tables. 25 pg.